

# Addressing



# Addressing Issues

- Types of data that can be addressed
- Addressing modes

# Data Types

- Hardware support is needed for the data types referenced by an instruction.
- Data types that need to be supported
  - Numeric:
    - integers (signed and unsigned) with lengths short (16 bit) or long (32 bit)
    - floating point with lengths of 32, 64 and 128 bits
  - Non-numeric:
    - mainly strings

# Addressing Modes (I)

- Specify how an operand is accessed
    - E.g., constant, a register, or a memory location
  - Some types of addressing modes
    - Immediate
    - Base / Indexed
    - Direct
    - Register
    - PC-relative
    - Indirect
- MIPS** - Load and store only instructions access memory

# Addressing Modes (II)

- Immediate
  - The operand contains the value of the datum.
  - Eg: `add $r4, $r2, #5`  
`$r4 = Data in register $r2 + 3`
- Direct (pseudo-direct for MIPS)
  - The operand contains the memory address of the datum.
  - Eg: `add $r4, $r2, (1024)`  
`$r4 = Data in register $r2 + Data at memory address 1024`
- Register
  - The operand contains the register designation where the datum is located.
  - Eg: `add $r4, $r2, r3`  
`$r4 = Data in register $r2 + Data in register $r3`

# Addressing Modes (III)

- PC-relative

- The operand contains the offset from the PC

- Eg: **beg \$r1, \$r2, 25**

If ( $\$r1 = \$r2$ ) go to  $PC = PC + \text{offset} (25)$

PC – Program Counter

- base / Indexed

- A register contains a base address and an operand holds a displacement from this base

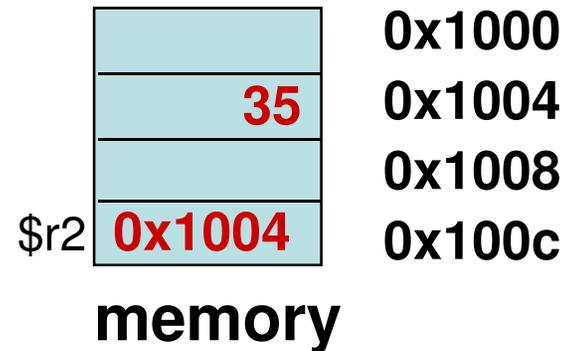
**Note:** the base register may be another operand or implicit

- Eg: **lw \$r1, 100(\$r2)**

$r1 = \text{Memory}(r2 + 100)$

# Addressing Modes (IV)

- Indirect
  - The operand contains the (memory) address of the datum
  - E.g: **LD \$r3, (\$r2)**  
\$r3 = Contents of memory address in register \$r2

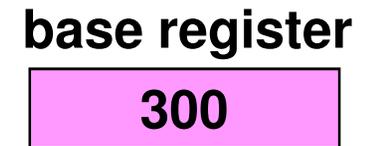
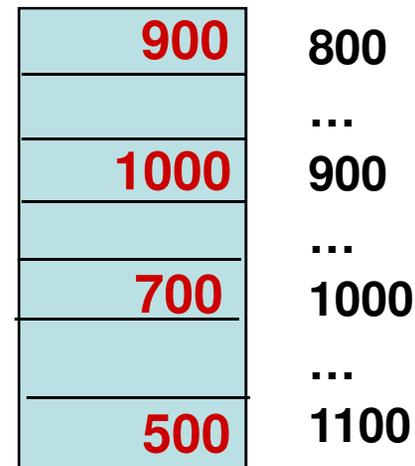


# Addressing Modes – Example

Consider the instruction LOAD \$R1, 800

Which value is loaded into register \$R1 for each addressing mode?

- Immediate
- Direct
- Base
- Indirect



# Addressing Modes – Answers

- Immediate - 800
- Direct – 900 (800 contains the intended value)
- Base - 500 (800 is added to the content of the base register = 300, which gives 1100, and the content of word 1100 is retrieved)
- Indirect– 1000 (800 has the memory address 900, and memory address 900 contains the value)

